PROGRESS IN CRYSTAL GROWTH AND CHARACTERIZATION OF MATERIALS

Volume 20

Edited by

PROFESSOR J. B. MULLIN

"The Hoo", Brockhill Road, West Malvern, Worcestershire, WR14 4DL, U.K.

PERGAMON PRESS
OXFORD · NEW YORK · SEOUL · TOKYO

PROGRESS IN CRYSTAL GROWTH AND CHARACTERIZATION OF MATERIALS

Editor in Chief
Professor J. Brian Mullin
"The Hoo", Brockhill Road, West Malvern, Worcestershire WR14 4DL, U.K.

Associate Editors
Professor P Krishna, *Banaras Hindu University, India*
Dr Claude Schwab, *C.R.N./GRPM, Strasbourg, France*
Dr N B Singh, *Westinghouse, Pittsburgh, U.S.A.*

Editorial Board

Professor I Sunagawa
Tokyo, Japan

Professor Carlo Paorici
MASPEC, Parma, Italy

Dr E I Givargizov
Moscow, Russia

Dr D Elwell
Newport Beach, California, U.S.A.

Professor Jiang Minhua
Shandong Univ, China

Professor Manni Mooser
Lausanne, Switzerland

Dr R Z Bachrach
Palo Alto, California, U.S.A.

Professor P Ramasamy
Madras, India

Professor T Ohachi
Kyoto, Japan

Dr K Byrappa
Mysore, India

Dr P Shlichta
San Pedro, California, U.S.A.

Dr J Venkrbec
Prague, Czechoslovakia

Progress in Crystal Growth and Characterization of Materials is published as two volumes of four parts per year: January, March, May, June, August, September, November, December.

©1993 Pergamon Press Ltd

Annual Institutional Subscription Rate (1993): £550.00 (US$880.00). Sterling prices are definitive. US dollar prices are quoted for convenience only, and are subject to exchange rate fluctuation. Prices include postage and insurance and are subject to change without notice. Subscription rates for Japan are available on request. Specially Reduced Rates to Individuals: Any Individual whose institution takes out a library subscription may purchase a second or additional subscription for personal use at a much reduced rate. Prices are subject to change without notice. Subscription enquiries from customers in North America should be sent to Pergamon Press Inc., 660 White Plains Road, Tarrytown, NY 10591-5153, U.S.A., and for the remainder of the world to Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 0BW, U.K.

Back issues of all previously published volumes are available direct from Pergamon Press offices.

Second class postage paid at RAHWAY NJ. Postmaster send address corrections to *Progress in Crystal Growth and Characterization of Materials*, c/o Pergamon Press Inc., 660 White Plains Road, Tarrytown, NY 10591-5153, U.S.A.

Publishing/Advertising Offices

Pergamon Press Ltd
Headington Hill Hall
Oxford OX3 0BW
U.K.

Pergamon Press Inc
660 White Plains Road
Tarrytown
NY 10591-5153, U.S.A.

CONTENTS

Editorial: Growth and Characterization of Nonlinear Optical Materials
Edited by N. B. SINGH

Preface v

The need for nonlinear optical materials 1
J. A. NEFF

Growth and characterization of nonlinear optical crystals suitable for frequency conversion 9
L. K. CHENG, W. R. BOSENBERG and C. L. TANG

Progress in nonlinear optical materials for high power lasers 59
D. EIMERL, S. VELSKO, L. DAVIS and F. WANG

Growth of nonlinear crystals for frequency conversion 115
R. S. FEIGELSON, R. J. RAYMAKERS and R. K. ROUTE

Recent developments in the growth and nonlinear optical applications of $KNbO_3$ crystals 161
D. Z. SHEN

Growth and characterization of thallium arsenic selenide crystals for nonlinear optical applications 175
N. B. SINGH, T. HENNINGSEN, Z. K. KUN, K. C. YOO, R. H. HOPKINS and R. MAZELSKY

Insight into the genesis of irregularity during crystal growth achieved through high sensitivity monochromatic synchrotron x-radiation diffraction imaging (topography) 189
B. STEINER, M. KURIYAMA and R. C. DOBBYN

Phase equilibria and crystal chemical relations in copper–nickel–selenium system 217
M. SINGH and S. BHAN

Characterisation of heteroepitaxial compound semiconductor layers and superlattices using transmission electron microscopy 231
H. CERVA and H. OPPOLZER

Kinetics and mechanisms of flux crystal growth 263
P. GÖRNERT

Growth and properties of GaSb, $Ga_{1-x}In_xSb$ and $Ga_{1-x}Al_xSb$ epilayers by MOCVD 285
F. SHYANG JUANG and Y. KUIN SU

On conductivity in lead chalcogenides 313
G. P. KOTHIYAL and B. GHOSH